

NASA

LOCKHEED MARTIN A

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

**NASA RESEARCH ANNOUNCEMENT
CONTRACT NAS8-39929
LOCKHEED MARTIN ASTRONAUTICS / NASA MSFC**

**GERRY BJORKMAN LOCKHEED MARTIN MICHoud SPACE SYSTEMS
DR. ALEX CHO REYNOLDS METALS Co**

**CAROLYN RUSSELL NASA MSFC
FRANK ZIMMERMAN NASA MSFC**

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

SUMMARY

- INTRODUCTION
- OBJECTIVE
- APPROACH
- FILLER WIRE CHEMISTRY FORMULATION
- WELD EVALUATION
- DOWNSLECT
- DOWNSLECT WELD EVALUATION
- CONCLUSIONS

NASA

LOCKHEED MARTIN

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

INTRODUCTION



0.320"t 2195 PLATE-TO-2195 PLATE ER2319

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

OBJECTIVE

IDENTIFY AN AI-CU BASED FILLER WIRE CHEMISTRY WHICH REDUCES
WELD CRACK SUSCEPTIBILITY IN 2195 ALUMINUM-LITHIUM WELDS
AND REPAIR WELDS ALONG WITH PROVIDING ADEQUATE MECHANICAL
PROPERTIES.

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

APPROACH

FILLER WIRE FORMULATION
(14) CHEMISTRIES

AUTOMATED
VPPA WELDING

MANUAL GTA
REPAIR WELDING

MANUAL GTA
TACK WELDING

FILLER WIRE CHEMISTRY DOWNSSELECT
(3) CHEMISTRIES

AUTOMATED
VPPA WELDING

MANUAL GTA
REPAIR WELDING

FILLER WIRE CHEMISTRY RECOMMENDATION

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

FILLER WIRE CHEMISTRIES

- (8) DOE CHEMISTRIES Cu, Li, Mg, Ag, Zn, Mn, V, Ti, Zr
- 2195 CHEMISTRY
- (5) 2319 VARIANT CHEMISTRIES Cu, Sc, Zr

NASA

LOCKHEED MARTIN

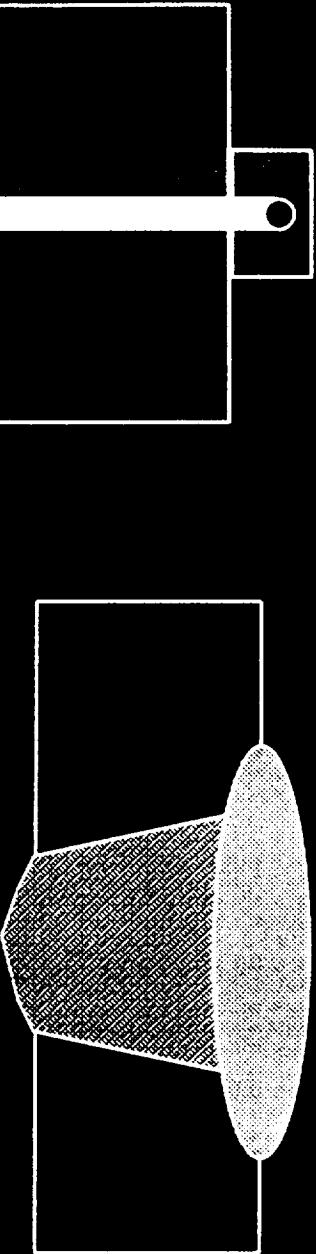
FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

WELDING

- AUTOMATED VPPA WELDING
- MANUAL GTA REPAIR WELDING
- MANUAL GTA TACK WELDING

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

VPPA WELDING



- (2) 16" LONG TEST PANELS WELDED

- (3) RT AS-WELDED TENSILES
- (3) RT SHAVED TENSILES
- (2) RT J1c CENTERLINE
- (2) RT J1c FUSION LINE
- (3) SCC
- (6) MET. SAMPLES

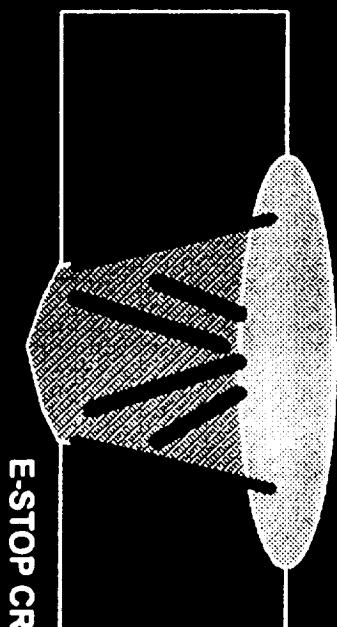
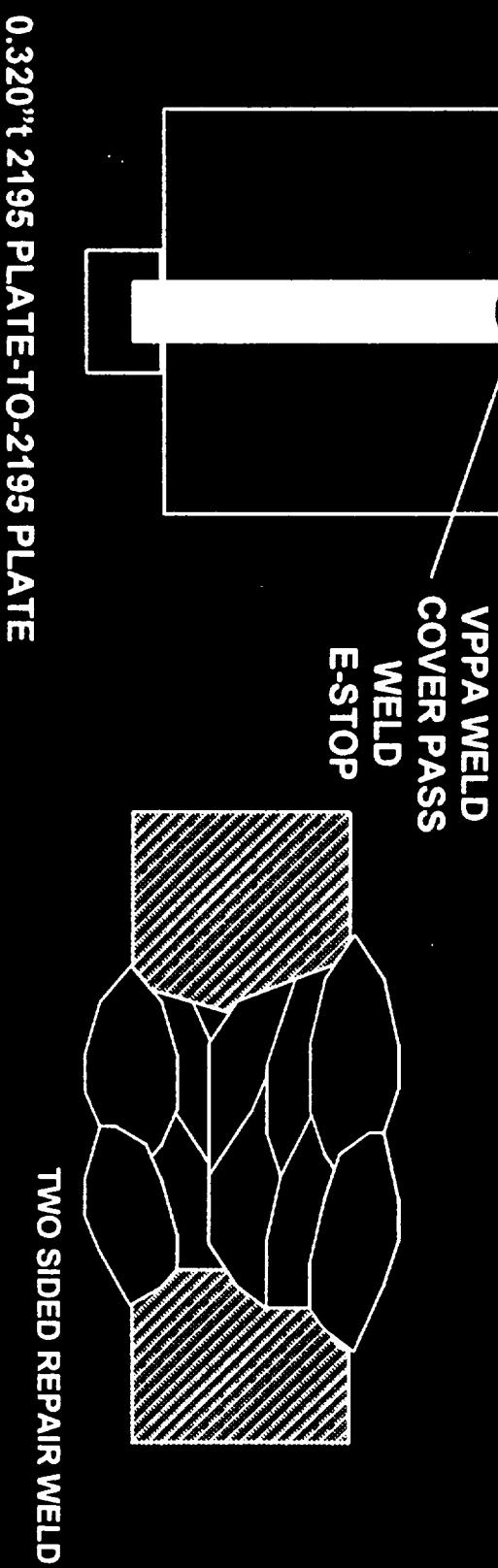
0.320"t 2195 PLATE-TO-2195 PLATE

NASA

LOCKHEED MARTIN

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

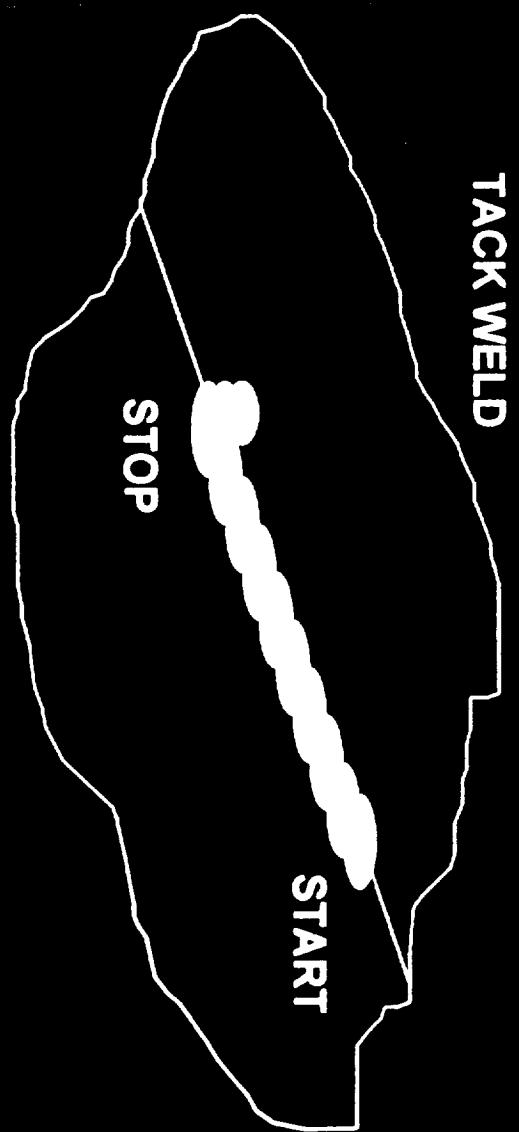
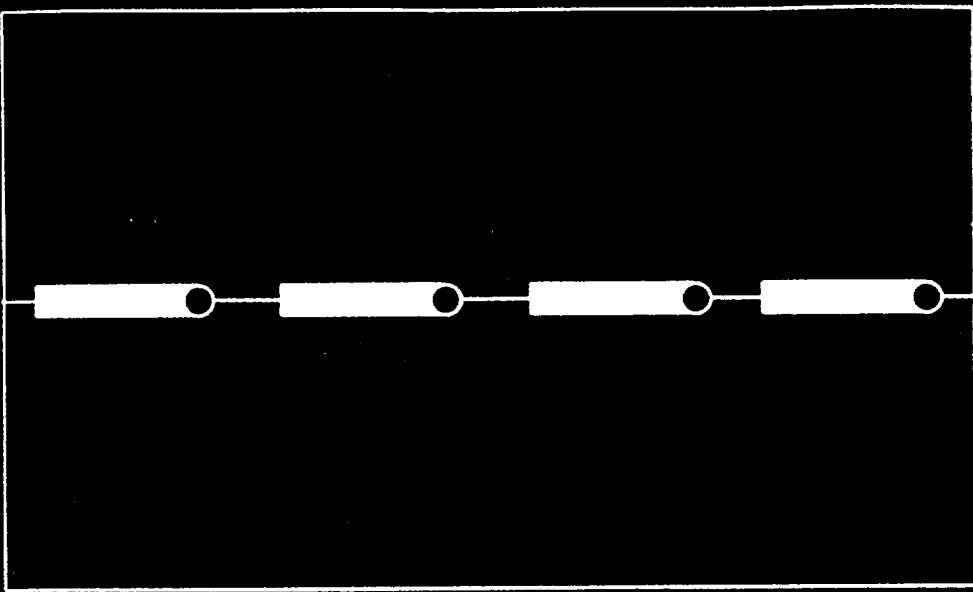
MANUAL GTA REPAIR WELDING



NASA

LOCKHEED MARTIN

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM
MANUAL GTA TACK WELDING



0.320"t 2195 PLATE-TO-2195 PLATE



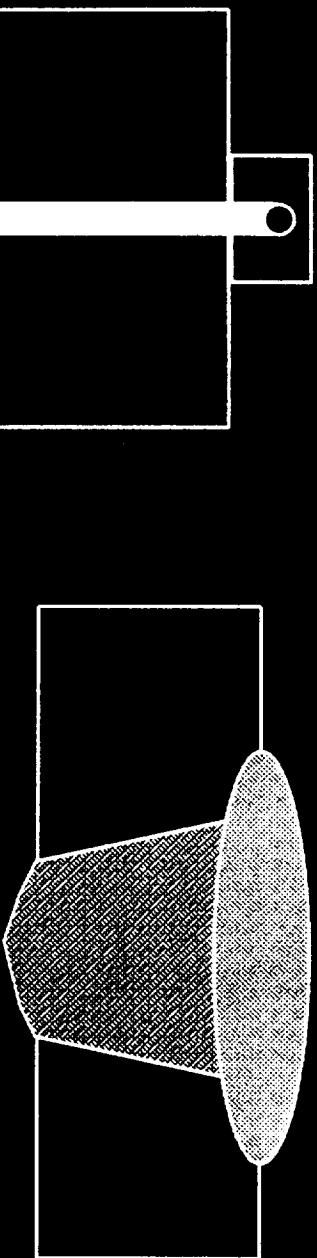
FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

FILLER WIRE CHEMISTRY DOWNSSELECT

(3) Filler Wire Chemistries Cu, Ag, Zn, Mg, Ti, Zr

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

DOWNSELECT VPPA WELDING



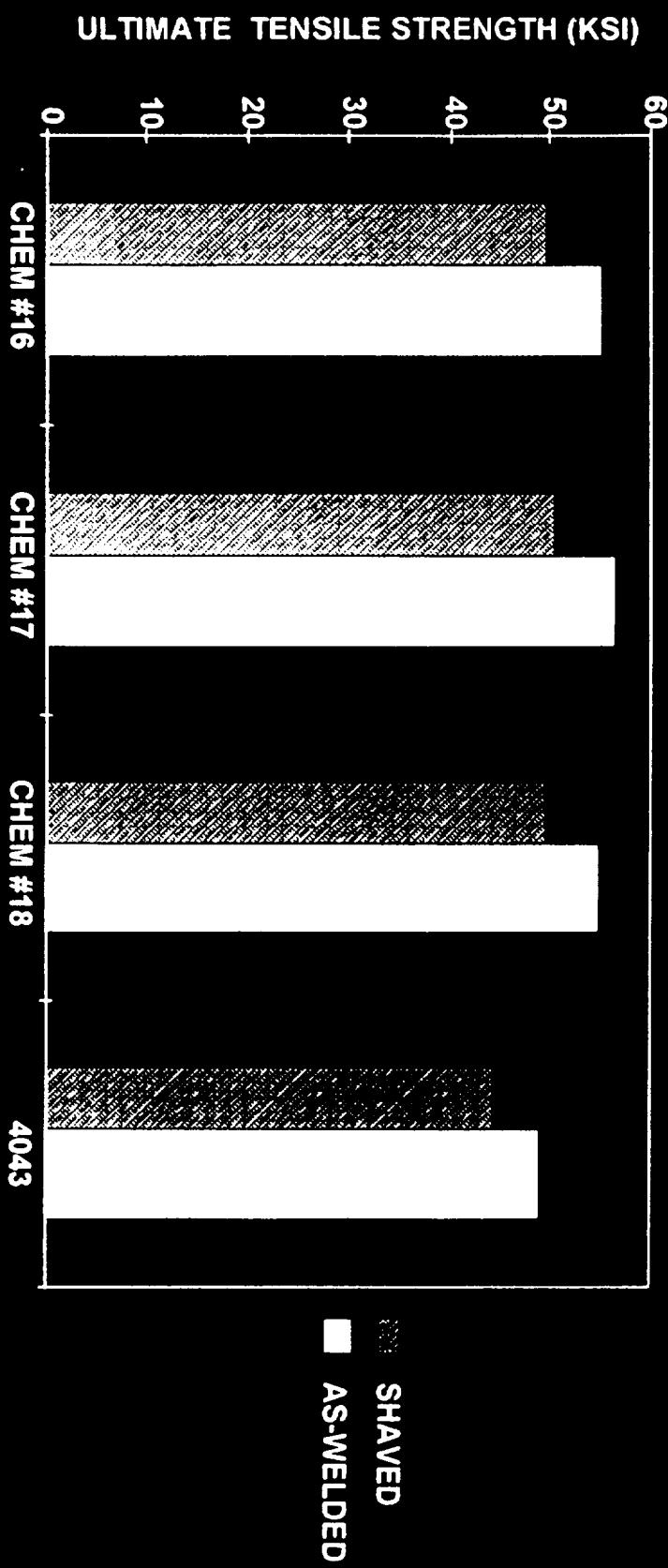
- (2) 16" LONG TEST PANELS VPPA WELDED

- (3) RT AS-WELDED TENSILES
- (3) RT SHAVED TENSILES
- (3) RT J1c CENTERLINE
- (3) LN2 J1c CENTERLINE
- (3) SCC
- (6) MET. SAMPLES

0.320"t 2195 PLATE-TO-2195 PLATE

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

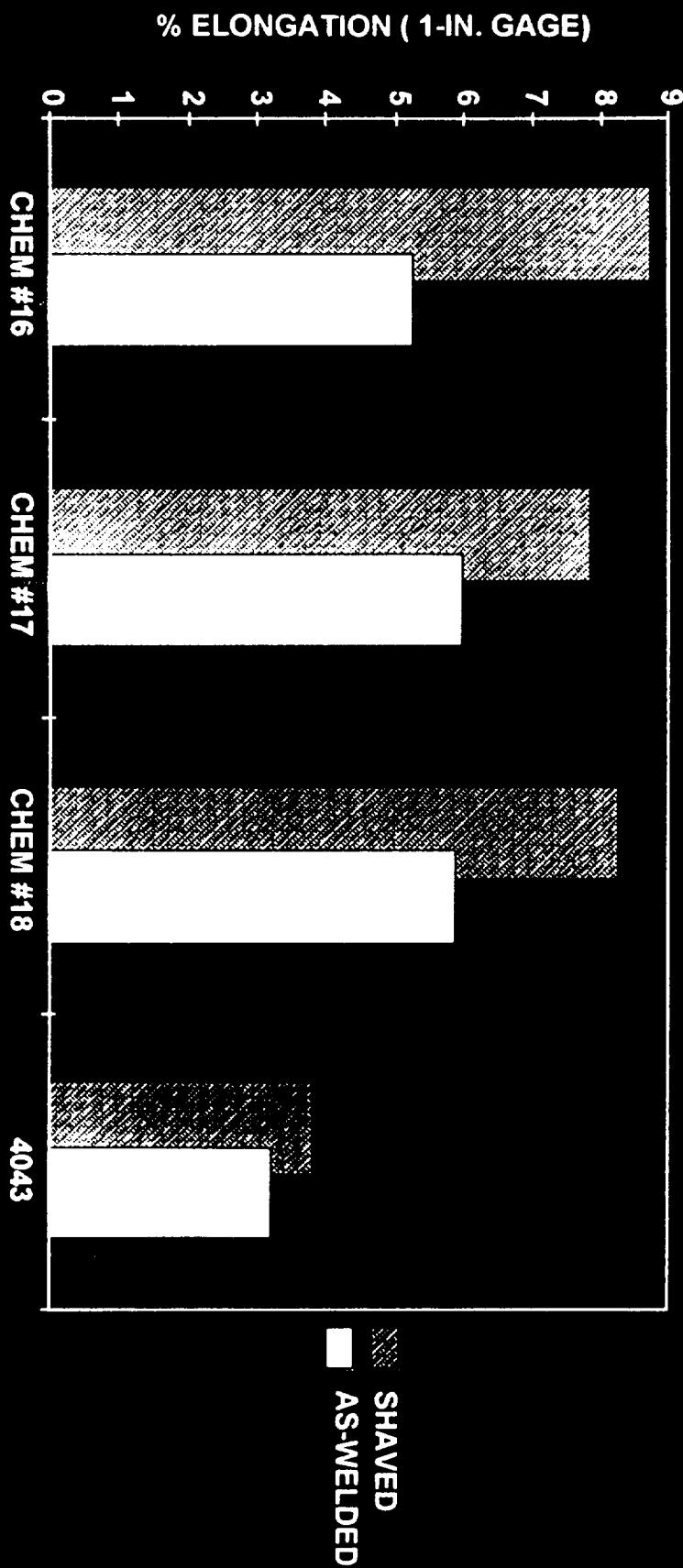
DOWNSIZE VPPA WELDING WELD ULTIMATE TENSILE STRENGTH



FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

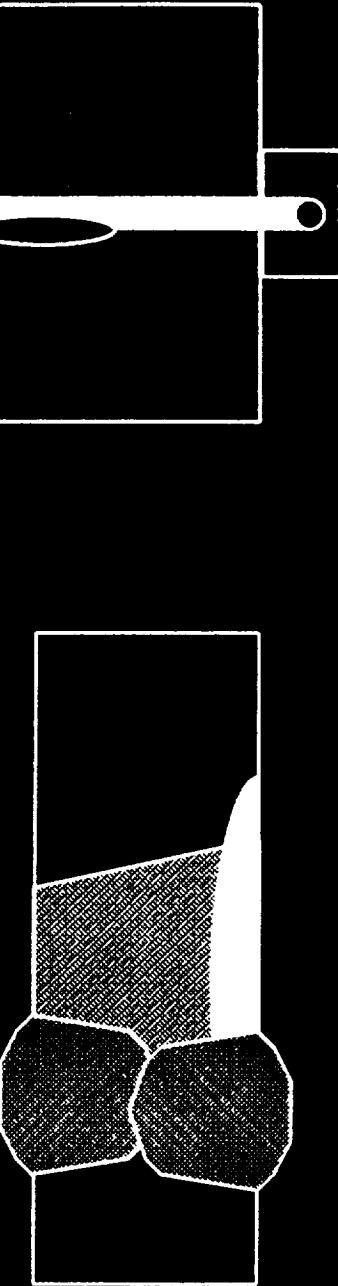
DOWNSLECT VPPA WELDING

WELD ELONGATION



FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

DOWNSELECT MANUAL GTA REPAIR WELDING



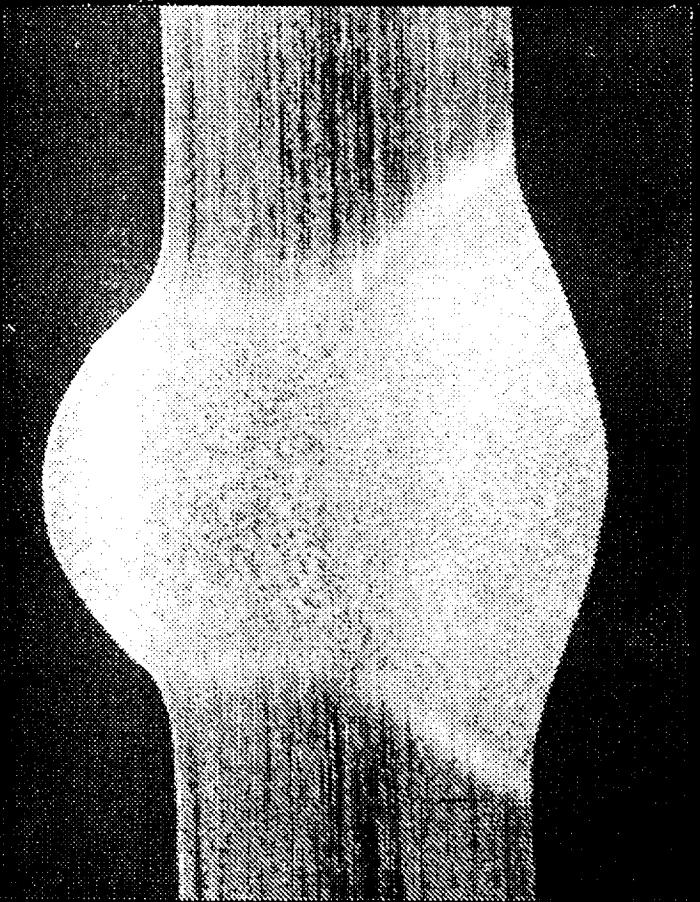
- (2) 24" LONG TEST PANELS VPPA WELDED

- (4) RT SHAVED TENSILES
- (4) LN2 SHAVED TENSILES
- (3) RT J1c REPAIR FUSION LINE
- (3) LN2 J1c REPAIR FUSION LINE
- (3) RT J1c VPPA FUSION LINE
- (3) LN2 J1c VPPA FUSION LINE

NASA

LOCKHEED MARTIN A

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM
DOWNSELECT MANUAL GTA REPAIR WELDING

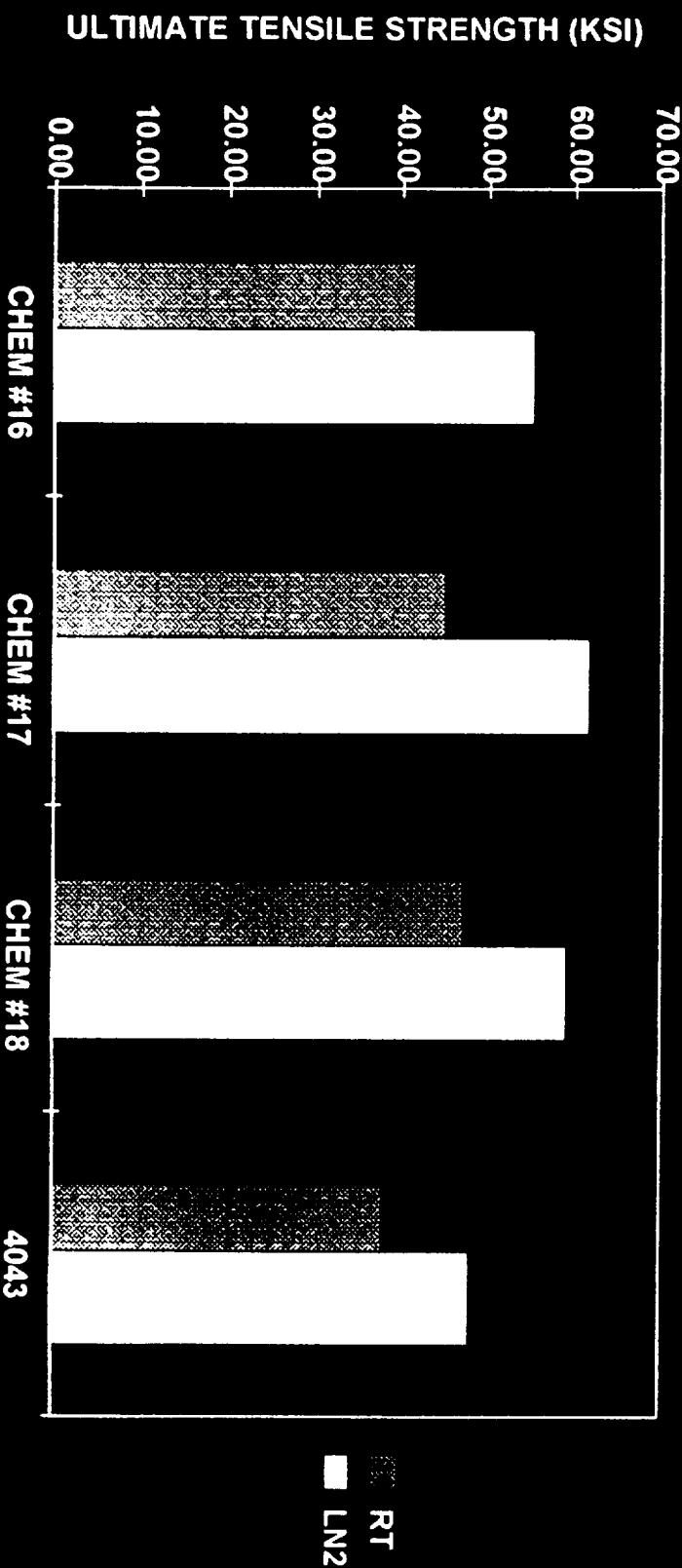


0.200"t 2195 PLATE-TO-2195 PLATE VPPA WELD

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

DOWNSLECT MANUAL GTA REPAIR WELDING

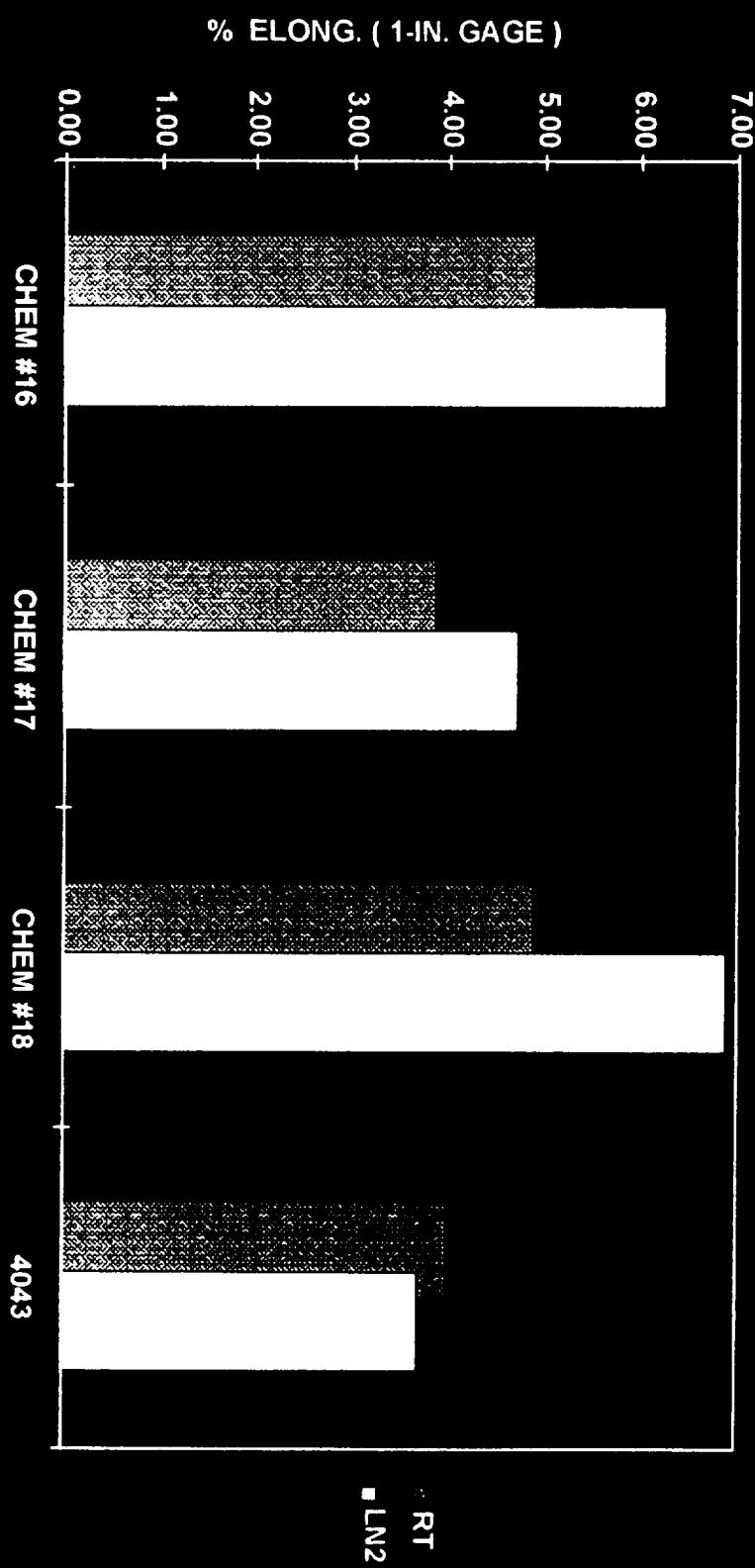
REPAIR WELD ULTIMATE STRENGTH



FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

DOWNSSELECT MANUAL GTA REPAIR WELDING

REPAIR WELD ELONGATION

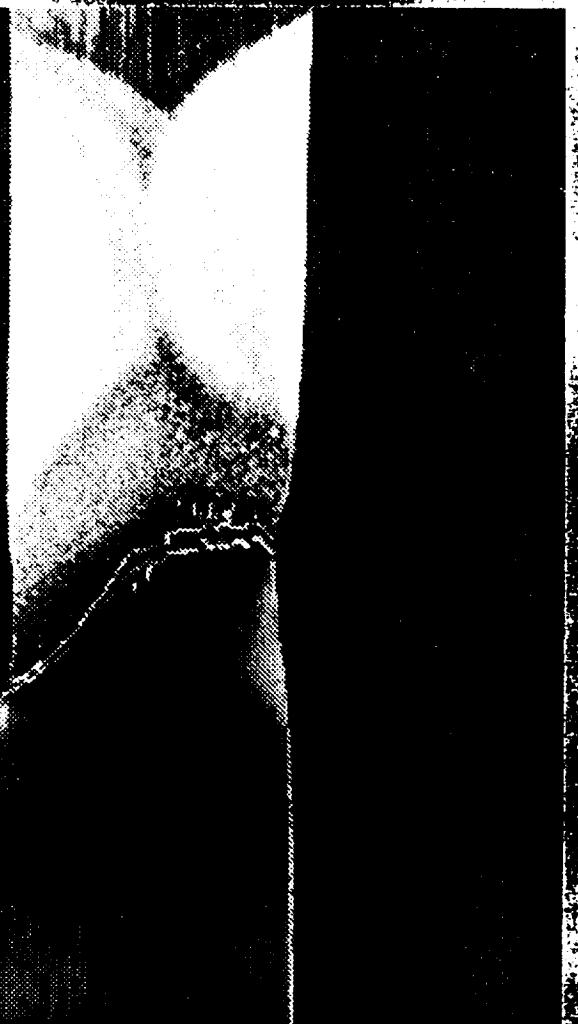


NASA

LOCKHEED MARTIN

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

DOWNSLECT MANUAL GTA REPAIR WELDING



0.200" 2195 PLATE-TO-2195 PLATE R5 GTA REPAIR WELD

NASA

LOCKHEED MARTIN

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM

FILLER WIRE CHEMISTRY

CONCLUSIONS

FILLER WIRE DEVELOPMENT FOR 2195 ALUMINUM-LITHIUM OBJECTIVE

**IDENTIFY AN AI-CU BASED FILLER WIRE CHEMISTRY WHICH REDUCES
WELD CRACK SUSCEPTIBILITY IN 2195 ALUMINUM-LITHIUM WELDS
AND REPAIR WELDS ALONG WITH PROVIDING ADEQUATE MECHANICAL
PROPERTIES.**